are parallel with its equator, the axial extremities become well-defined poles.

Place the equator of the sphere, the light, and the eye, in the same plane, and the axis of the sphere vertical to it. Make the reflective angle as acute as possible. The reflection is a central luminous point

FIG. 3.

FIG. 4.

at the equator in a vertical band terminating acutely toward either pole, fig. 3. If the reflective angle is about 90°, the reflection is crescentic, fig. 4. When the sphere is placed remote from the light and the eye, with its axis inclined toward the light, the reflection is a luminous point at its proximal pole, fig. 5.

If the sphere is brought nearer the light, thus increasing the reflective angle, a short curved tail de-

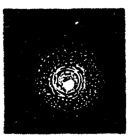

FIG. 5.

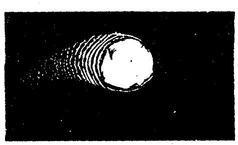

FIG 6.

velops, fig. 6. This increases in length as the sphere is approached to the light, until, at close proximity, *a*, in fig. 7, results. Removal of the reflecting surface at any latitude on the sphere interrupts the reflection, as at *c*, fig. 7. The interposition of a comparatively small opaque body before the light, when the inclined sphere is in *very* close proximity to the light, divides the reflection, — *a*, *b*, fig. 7. Multiple sources of light multiply the reflections, which describe different curves, all radiating from, though not always reaching, the pole. The greater the sphere in relation to the source of light, the more perfectly the form of the luminous point is reflected. If circular, it appears as a disk or brilliant nucleus. The extension of the reflection toward the equator constitutes a diverging train or tail.

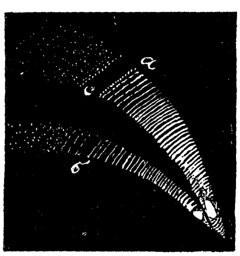

FIG. 7.

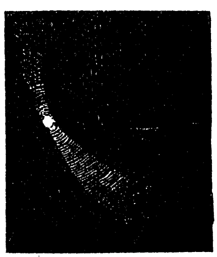

FIG. 8.

Changes in the positions of the three factors produce a limitless variety of figures, which are suggestive of various cometic forms: for instance, fig. 8, two opposite spherical sectors, the analogue of figs. 1 and 2. The resemblance of the reflections to cometic appearances is increased if the striated reflecting sphere, with the inclined axis maintained, is made to describe about a light approximately the form of a comet's orbit; then all the changes exhibited by a comet, from the first nebulous point to the fully-developed tail, are illustrated upon its surface, including the changes in the position of the tail in relation to the light, which occur during the small curve of a comet's orbit. The reflections describe all the radii between *a* and *b*, fig. 9. It is surprising to what extent cometic behavior may be illustrated upon the polished spheres: position, elongation, abbreviation, disappearance, annular images, irregular images, are all quite possible.

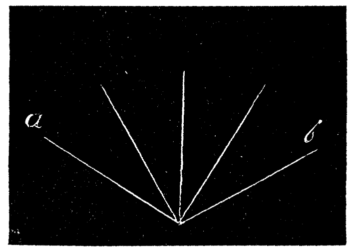

FIG. 9.

If an hypothesis may be ventured, it is briefly this: if a sphere of meteoric dust of a diameter exceeding the greatest length of the comet's train, having an axial rotation and inclination, does actually traverse the comet's orbit, such a rotation would convert its superficial inequalities, varying densities, and possibly its individual atoms, in effect, into continuous striae, parallel with its equator; and such inclination would place it in position to reflect the images which comets display. Discussion of the hypothesis is reserved.

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THE BIOLOGICAL INSTITUTE AT PHILADELPHIA.

NOT a few of the readers of *Science* are looking upon the new departure in biology in Philadelphia with high hopes that it may become one of our most valued possessions. They regard it as a new and therefore great opportunity. But they will be sadly disappointed if its officers give themselves up largely to merely routine teaching, or are satisfied in taking a position towards biological science in any large degree conservative. The United States is a poor field, or is rapidly becoming so, for the perpetuation of ancient methods in one of the youngest and most vigorously growing of the sciences. And if any one cares to profit by experience, let him reflect upon those steps, which, within ten years, have led up to one of our most valued institutions, — the Johns Hopkins university, — or to the almost incredible success of the Naples station. Broadly speaking, their conditions of prosperity have been two, — on the one hand, money;

on the other, methods. A firm financial basis is always absolutely indispensable; and this, we understand, the new department is to have in abundance. The second requisite is equally imperative. The university just now mentioned had abundant means; so had others before it: but it invoked new methods. True, these seemed to some, at the outset, revolutionary; but who can deny that they have been a success? It was because of this great importance of absolute freedom that some felt it to be safer for the new establishment in Philadelphia to steer clear of affiliations, however exalted; and it was for this reason alone. The advantages accruing to both the University of Pennsylvania and the biological institute (or department), by union, are too obvious to need discussion; and both are to be congratulated, provided only that that liberty be granted which will insure the employment of the best methods.

As to the exact line of work to be done, or the methods to be set going, we may safely trust to the discretion of the new faculty. Evidently, museum-work in the older sense, and elementary teaching by the older methods, may be neglected. And it will very likely be found true that great opportunities are embraced in the hunt for new methods of work, — in technique, — and especially in field-work at the sources of supply. The American mind is quick, inventive, ingenious. Must it always go abroad to get new 'points'? Let it, rather, come to prove its ingenuity by original biological methods at home; then, with application of these at the sources of supply, — at the laboratory table, by the shores of the sea, by the river or the gulf, — we may solve those home problems which are most pressing. It is not too much to say that the eyes of the biologists of Europe are upon us and upon our material. Moreover, if, as is certain, the field is white for the harvest, need the reapers be few? or those few, Europeans?

And let us by no means forget our greatest opportunity. In the variety of our environments, and in the area of our country, we have conditions highly favorable for the study of those final broader physiological problems which must eventually be the key to life-science as a whole. We wish the new biological department every possible success.

THE ENEMIES AND PARASITES OF THE OYSTER, PAST AND PRESENT.

AMONG the worst enemies of the oyster of our Atlantic coast are the star-fishes; and great numbers of them are usually found upon all oyster-beds, where they are committing depredations upon the mollusks. It is an interesting fact, however, that the remains of star-fishes are rarely found in connection with fossil oysters of any age, not even with tertiary oysters. The oyster family culminated in the cretaceous period, as regards generic differentiation. The abundance of individuals was also as great then as it has ever been since; and it is often the case that the remains of oysters are found in great profusion in both cretaceous and tertiary strata. The cretaceous strata of Texas have furnished a great abundance of the Ostreidae of every generic and subgeneric form known upon this continent; and yet, among all the many collections of fossils from those rocks which I have examined, I have never seen a fragment of a star-fish, although echinoids in considerable variety are not uncommon.

Star-fishes very closely related to those now living upon our coast have been reported by Forbes from Jurassic strata, and I have recognized a similar form from the Neocomian of Brazil; but we have no evidence that star-fishes of any kind were ever a serious enemy to the oyster before the present epoch. The ancient star-fishes, no doubt, had the same propensities that their modern representatives have; but they seem not to have obtained that preponderance then which they have since acquired.

Burrowing sponges similar to, if not identical with, the living Cliona, are of very ancient origin. The fossil shells of the ostreid genera Exogyra and Gryphaea, as well as those of Ostrea proper, are as commonly and completely 'riddled' by burrowing sponges as are any shells of the living oyster. Indeed, it is rare to find even a small collection of fossil oyster-shells free from such burrows. Other fossil shells besides those of the Ostreidae are found to have been thus infested, the burrows being in all respects the same as those which infest the oysters.

Not only did Cliona exist abundantly with the Ostreidae of mesozoic time, but I have obtained evidence that it also existed in paleozoic time in essentially the same character that it has to-day. Several years ago I obtained from the Devonian strata of Iowa some shells of the brachiopod genus Strophomena, which contain numerous Cliona-like burrows. These I submitted to Prof. A. E. Verrill, who informed me that in his opinion they are the borings of a species of Cliona.

C. A. WHITE.